INDUSTRIAL COMPUTER SOURCE®

Model DIOxx(S)I
Product Manual

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INDUSTRIAL COMPUTER SOURCE®

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FOREWARD

This product manual provides information to install, operate and or program the referenced product(s) manufactured or distributed by Industrial Computer Source. The following pages contain information regarding the warranty and repair policies.

Technical assistance is available at: **1-800-480-0044**.

Manual Errors, Omissions and Bugs: A "Bug Sheet" is included as the last page of this manual. Please use the "Bug Sheet" if you experience any problems with the manual that requires correction.

Guarantee

A thirty day money-back guarantee is provided on all **standard** products sold. **Special order products** are covered by our Limited Warranty, *however they may not be returned for refund or credit. EPROMs, RAM, Flash EPROMs or other forms of solid electronic media are not returnable for credit - but for replacement only. Extended Warranty available. Consult factory.*

Refunds

In order to receive refund on a product purchase price, the product must not have been damaged by the customer or by the common carrier chosen by the customer to return the goods, and the product must be returned complete (meaning all manuals, software, cables, etc.) within 30 days of receipt and in as-new and resalable condition. The **Return Procedure** must be followed to assure prompt refund.

Restocking Charges

Product returned *after* 30 days, and *before* 90 days, of the purchase will be subject to a **minimum** 20% restocking charge and any charges for damaged or missing parts.

Products not returned within 90 days of purchase, or products which are not in as-new and re-saleable condition, are not eligible for credit return and will be returned to the customer.

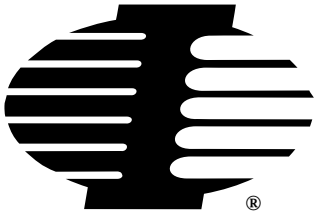
Limited Warranty

One year limited warranty on all products sold with the exception of the "Performance Series" I/O products, which are warranted to the original purchaser, for as long as they own the product, subject to all other conditions below, including those regarding neglect, misuse and acts of God. Within one year of purchase, Industrial Computer Source will repair or replace, at our option, any defective product. At any time after one year, we will repair or replace, at our option, any defective "Performance Series" I/O product sold. This does not include products damaged in shipment, or damaged through customer neglect or misuse. Industrial Computer Source will service the warranty for all standard catalog products for the first year from the date of shipment. After the first year, for products not manufactured by Industrial Computer Source, the remainder of the manufacturer's warranty, if any, will be serviced by the manufacturer directly.

The **Return Procedure** must be followed to assure repair or replacement. Industrial Computer Source will normally return your replacement or repaired item via UPS Blue. *Overnight delivery or delivery via other carriers is available at additional charge.*

The limited warranty is void if the product has been subjected to alteration, neglect, misuse, or abuse; if any repairs have been attempted by anyone other than Industrial Computer Source or its authorized agent; or if the failure is caused by accident, acts of God, or other causes beyond the control of Industrial Computer Source or the manufacturer. Neglect, misuse, and abuse shall include any installation, operation, or maintenance of the product other than in accordance with the owners' manual.

No agent, dealer, distributor, service company, or other party is authorized to change, modify, or extend the terms of this Limited Warranty in any manner whatsoever. Industrial Computer Source reserves the right to make changes or improvements in any product without incurring any obligation to similarly alter products previously purchased.



Shipments not in compliance with this Guarantee and Limited Warranty Return Policy will not be accepted by Industrial Computer Source.

Return Procedure

For any Limited Warranty or Guarantee return, please contact Industrial Computer Source's Customer Service at **1-800-480-0044** and obtain a Return Material Authorization (RMA) Number. All product(s) returned to Industrial Computer Source for service or credit **must** be accompanied by a Return Material Authorization (RMA) Number. Freight on all returned items **must** be prepaid by the customer who is responsible for any loss or damage caused by common carrier in transit. Returns for Warranty **must** include a Failure Report for each unit, by serial number(s), as well as a copy of the original invoice showing date of purchase.

> To reduce risk of damage, returns of product must be in an Industrial Computer Source shipping container. If the original container has been lost or damaged, new shipping containers may be obtained from Industrial Computer Source Customer Service at a nominal cost.

Limitation of Liability

In no event shall Industrial Computer Source be liable for any defect in hardware or software or loss or inadequacy of data of any kind, or for any direct, indirect, incidental, or consequential damages in connection with or arising out of the performance or use of any product furnished hereunder. Industrial Computer Source liability shall in no event exceed the purchase price of the product purchased hereunder. The foregoing limitation of liability shall be equally applicable to any service provided by Industrial Computer Source or its authorized agent.

Some *Sales Items* and *Customized Systems* are **not** subject to the guarantee and limited warranty. However in these instances , any deviations will be disclosed prior to sales and noted in the original invoice. ***Industrial Computer Source reserves the right to refuse returns or credits on software or special order items.***

Advisories

Three types of advisories are used throughout the manual to stress important points or warn of potential hazards to the user or the system. They are the Note, the Caution, and the Warning. Following is an example of each type of advisory:

Note: The note is used to present special instruction, or to provide extra information which may help to simplify the use of the product.

CAUTION!

A Caution is used to alert you to a situation which if ignored may cause injury or damage equipment.

WARNING!

A Warning is used to alert you of a situation which if ignored will cause serious injury.

Cautions and Warnings are accented with triangular symbols. The exclamation symbol is used in all cautions and warnings to help alert you to the important instructions. The lightning flash symbol is used on the left hand side of a caution or a warning if the advisory relates to the presence of voltage which may be of sufficient magnitude to cause electrical shock.

Use caution when servicing any electrical component. We have tried to identify the areas which may pose a Caution or Warning condition in this manual; however, Industrial Computer Source does not claim to have covered all situations which might require the use of a Caution or Warning.

You must refer to the documentation for any component you install into a computer system to insure proper precautions and procedures are followed.

Table of Contents

List of Figures

List of Tables

Current Revision 4A

April 1997

Chapter 1: Installation

Backing up the disk

The software provided with the DIO48I series is in DOS, 31/2" diskette format. As with any software package, you should make backup copies for everyday use and place your original master diskette in a safe location.

The easiest way to make a backup copy is to use the DOS DISKCOPY utility.

In a single-drive system the command is:

DISKCOPY A: A:

In a two-disk system the command is:

DISKCOPY A: B:

This will copy the contents of the master disk in drive A to the backup disk in drive B.

Hard Disk Installation

The files contained on the master diskette may also be copied onto your hard disk. To do this perform the following:

1.) Place the master diskette into a floppy drive.

2.) Change the active drive to the drive that has the master diskette installed. For example, if the diskette is the A drive, type A:

3.) Type INSTALL and follow the screen prompts.

Files contained on the disk are stored in separate directories as follows:

ROOT DIRECTORY:	Contains the FINDBASE PROGRAM that will help you to decide what base address to use with the card. Also contains the IDI48SET.EXE setup program.
PSAMPLES:	Contains Pascal sample.
CSAMPLES:	Contains “C” sample.
BSAMPLES:	Contains QuickBASIC sample.
VBACCES:	VisualBASIC utility driver that includes PEEK and POKE statements for reading and writing RAM as well as OUTPORT and INPORT for reading and writing port I/O. The driver is in the form of a DLL and allows you to access hardware as if the language was designed for it when you use VisualBASIC for Windows.

Installing the Card

Before installing the card carefully read the ADDRESS SELECTION and OPTION SELECTION Sections of this manual and configure the card according to your requirements. Use the special software program called **IDI48SET** provided on diskette with the card. It supplies visual aids to configure all areas of the board.

Be especially careful with address selection. If the addresses of two installed functions overlap, you will experience unpredictable computer behavior. If unsure what locations are available, you can use the FINDBASE program provided on our diskette to locate blocks of available addresses.

To install the card:

1. Remove power from the computer.

2. Remove the computer cover.

3. Remove blank I/O backplate.

4. Install jumpers for selected options. See OPTION SELECTION

5. Select the base address on the card. See ADDRESS SELECTION

6. Loosen the nuts on the strain relief bar and swing top end free.

7. Install the card in an I/O expansion slot. If convenient, select a slot adjacent to a vacant slot because this will make cable installation easier.

8. Thread the I/O cables, one by one, through the cutout in the mounting bracket and plug them into the headers.

9. Smooth the cables as close as possible to the card and, while holding them close to the surface of the card, swing the strain relief bar into position and tighten nuts.

10. Inspect for proper fit of the card and cables and tighten screws.

11. Replace the computer cover.

Chapter 2: Functional Description

Features

- Individually-Isolated Digital Inputs for up to Three 16-Bit Groups.
- Polarity-Protected Input Voltage Amplitudes to 28V and 60V.
- 500Vrms Isolation, Channel-to-Channel and Channel-to-Host PC.
- On-Board Shields Prevent Accidental Contact with User Voltages.
- The "S" and "SI" Series Models Can Generate Interrupts When Input Bits Change State.

Description

DIO48I Series cards provide individual-input optical isolation and accept as many as 48 parallel differential digital inputs at voltages up to 60 VDC. Protection circuits are included in case of accidental polarity reversal of input connections. These cards provide a much lower cost per point than externally-mounted, optically-isolated, solid-state modules or PLC's. Input connections are via ribbon-cable headers on the card and a tie-down bar is included to provide strain relief for those cables.

These cards are especially useful in applications where high-common-mode external voltages are present as found in factory automation, energy management, security systems, and process monitoring applications. In addition to protecting your computer from accidental contact with high external voltages, the isolation provided eliminates troublesome ground loops.

There are 48-bit, 32-bit, and 16-bit versions. The latter two models are de-populated versions of the 48-bit card. Further, letters are appended to the model numbers to signify options included on the card.

Model	No. of Bits	Max. Input Voltage	Change-of-State Interrupt Capability
DIO16I/28	16	28V	NO
DIO16SI/28	16	28V	YES
DIO16I/60	16	60V	NO
DIO16SI/60	16	60V	YES
DIO32I/28	32	28V	NO
DIO32SI/28	32	28V	YES
DIO32I/60	32	60V	NO
DIO32SI/60	32	60V	YES
DIO48I/28	48	28V	NO
DIO48SI/28	48	28V	YES
DIO48I/60	48	60V	NO
DIO48SI/60	48	60V	YES

The change-of-state interrupt capability included in “SI” models provides means to automatically interrupt the host computer in real time. When one or more input bits change state, latched interrupt requests are generated. That interrupt, in turn, can be used by your application program to initiate a poll of the inputs, then signal appropriate alarms, and/or initiate scan of other I/O points that have not been previously activated. This can greatly simplify your application program and eliminate need to continuously poll inputs. Interrupts IRQ2 through 7 (or IRQ 10-12 and 14-15 in AT-class computers) can be selected by jumper installation on the card.

An on-board microcontroller on “SI” version cards provides capability for a variety of modes of operation as follows:

a. Change-of-state Interrupt active on channels 0-15.(Mode Switch Position 0)

b. Change-of-state interrupt active on channels 16-31.(Mode Switch Position 1)

c. Change-of-state interrupt active on channels 32-47.(Mode Switch Position 2)

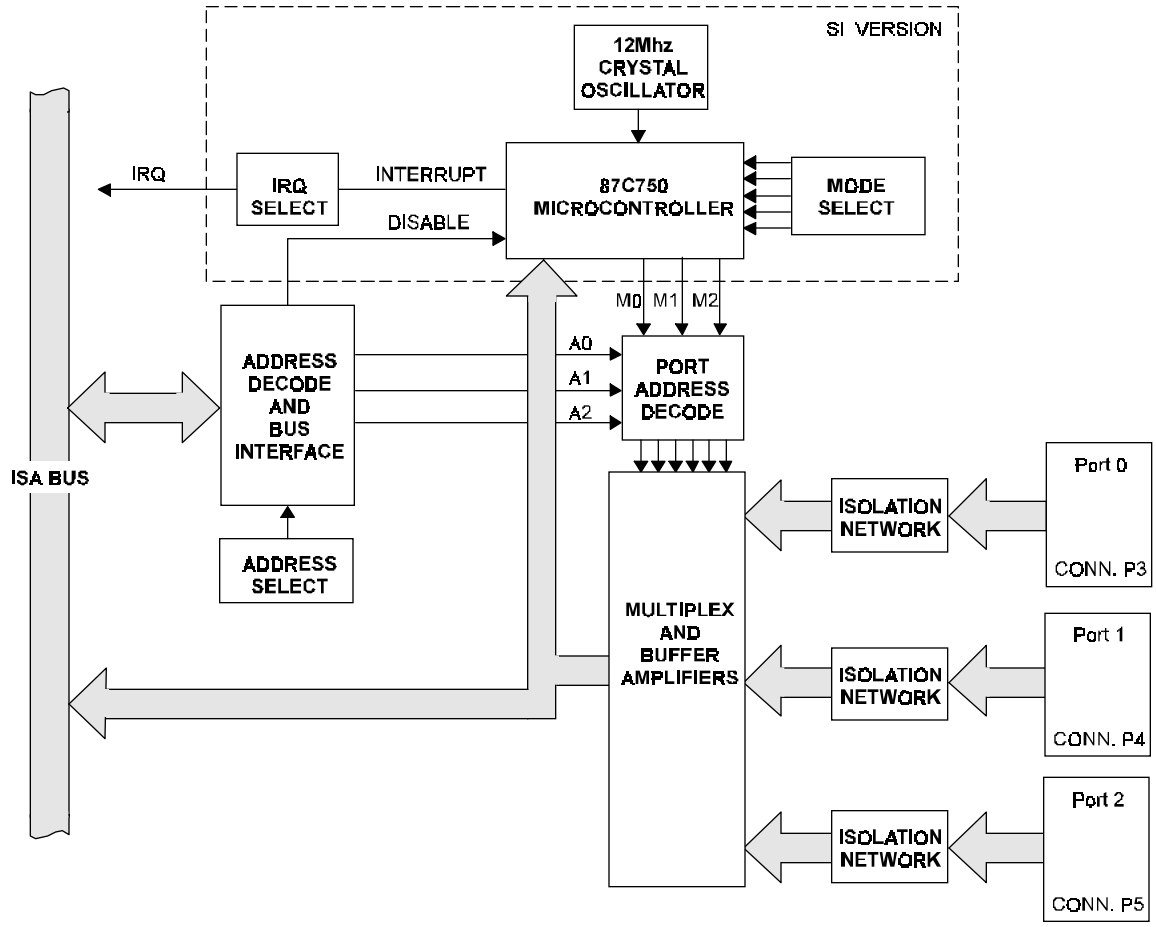


Figure 1: DIO48I Block Diagram

How to remain CE Compliant

In order for machines to remain CE compliant, only CE compliant parts may be used. To keep a chassis compliant it must contain only compliant cards, and for cards to remain compliant they must be used in compliant chassis. Any modifications made to the equipment may affect the CE compliance standards and should not be done unless approved in writing by Industrial Computer Source.

The Models DIO48I Series are designed to be CE Compliant when used in an CE compliant chassis. Maintaining CE Compliance also requires proper cabling and termination techniques. The user is advised to follow proper cabling techniques from sensor to interface to ensure a complete CE Compliant system. Industrial Computer Source does not offer engineering services for designing cabling or termination systems. Although Industrial Computer Source offers accessory cables and termination panels, it is the user's responsibility to ensure they are installed with proper shielding to maintain CE Compliance.

Chapter 3: Option Selection

Refer to the setup programs on the diskette provided with the card. Also, refer to the BLOCK DIAGRAM on the previous page and the OPTION SELECTION MAP on the following page when reading this section of the manual.

IRQ Selection

Interrupt levels IRQ2-7, 10-12, and 14-15 are available. Select the level that you want to use by installing a jumper in one of those locations.

Mode Switch (Note: This switch is only available in "SI" versions)

Positions 0, 1, and 2 are the only positions used in the standard versions of 16-, 32-, and 48-bit versions respectively. When these switches are ON, change-of-state interrupt operation is enabled for the associated Port 0, Port 1, and Port 2 groups of bits. The remaining two switches may be used in special versions of these SI-Series cards. If you have a special version, there is an Addendum sheet in the front of this manual describing the special modification that is included.

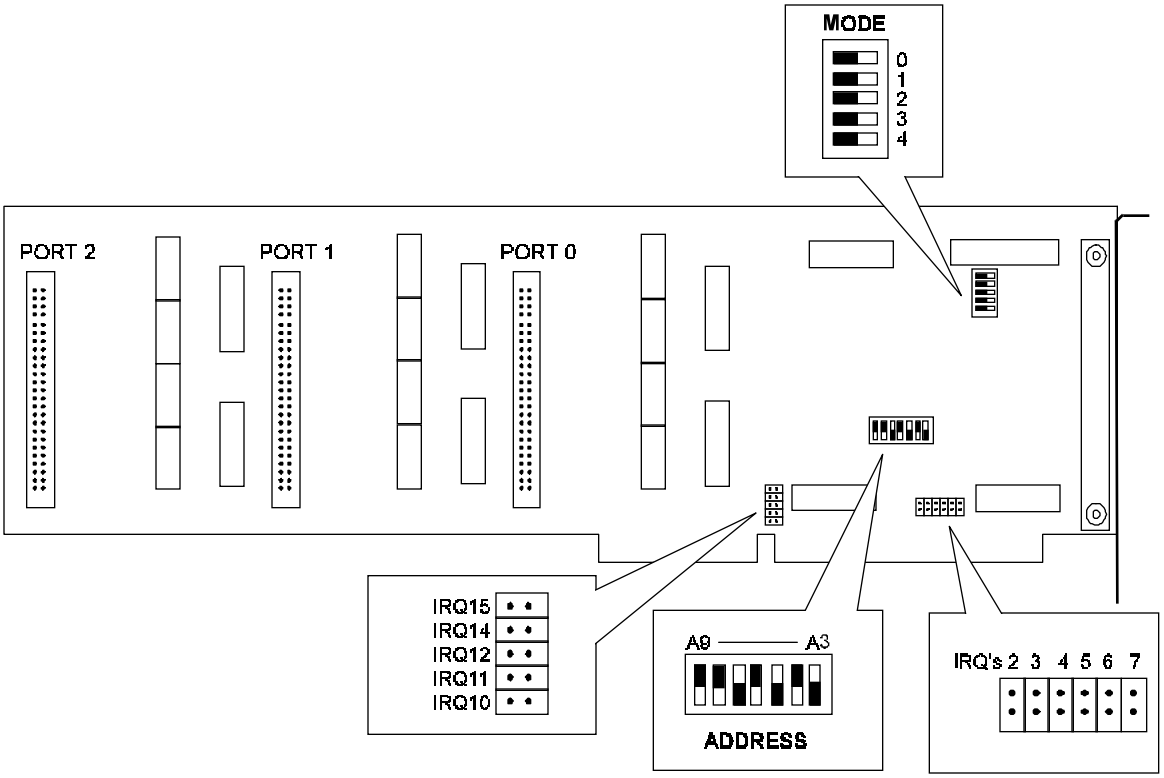


Figure 2: DIO48I Option Selection Map

Note: Prior to Rev B1 Boards, Ports 0 through 2 are in reverse order.

Chapter 4: Address Selection

The DIO48I card occupies eight bytes of I/O space. The card base address can be selected anywhere within the I/O address range 100-3F0 hex except 1F0 to 1F8. However two installed options cannot share the same address. If in doubt where to assign the base address, refer to the following table and the FINDBASE program to find an available address for your system.

STANDARD ADDRESS ASSIGNMENTS FOR PC AND PC/XT COMPUTERS

Hex Range	Usage
000-0FF	Internal System - Not Usable
1F0-1FF	AT Hard Disk
200-207	Game Control
278-27F	Parallel Port (LPT2)
238-23B	Bus Mouse
2E8-2EF	Asynchronous Communications (COM4)
2F8-2FF	Asynchronous Communications (COM2)
300-31F	Prototype Card
320-32F	XT Hard Disk
378-37F	Parallel Port (LPT1)
380-38F	SDLC Communications
3A0-3AF	SDLC Communications
3B0-3BB	MDA
3BC-3BF	Alt. Parrallel Port
3C0-3CF	EGA
3DO-3DF	CGA
3E8-3EF	Asynchronous Communications (COM3)
3F0-3F7	Floppy Disk
3F8-3FF	Asynchronous Communications (COM1)

** These options can not be used together - addresses overlap

To set desired board address, refer to the Board Address setup program on the Utility diskette provided with the card. Type the desired address in hexadecimal code and the graphic display shows you how to set the ADDRESS SETUP switches. These switches are marked A3-A9 and form a binary representation of the address in negative-true logic. (assign '0' to all ADDRESS SETUP switches turned ON, and assign '1' to all ADDRESS SETUP switches turned OFF.)

Switch Identification	A9	A8	A7	A6	A5	A4	A3
Address Line Controlled	A9	A8	A7	A6	A5	A4	A3

The following example illustrates the switch selection corresponding to hex 2D8 (or binary 10 11011xxx). The "xxx" represents address lines A2, A1, and A0 used on the Card to select individual inputs.

Hex Representation	2		D				8
Conversion Multipliers	2	1	8	4	2	1	8
Binary Representation	1	0	1	1	0	1	1
Set Up	OFF	ON	OFF	OFF	ON	OFF	OFF
Switch ID	A9	A8	A7	A6	A5	A4	A3

Note: Carefully review the address selection reference table on the previous page before selecting the card address. If the addresses of two installed functions overlap you will experience unpredictable computer behavior.

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Chapter 5: Software

Software Provided

Several programs are provided on the diskette with your card. There is a setup program, a program to help you select an I/O bus address that wont conflict with other computer resources, a DLL-form program for Windows users, and three sample programs to help you develop your applications software. These programs are as follows:

* IDI48SET: This is a menu-driven, pictorial program to help you set the card address, interrupt level, change-of-state interrupt, and high level interrupt enable.
* FINDBASE: Reports active and available address locations in your computer for assignment as the DIO48I card base address.
* SAMPLE1.C: This program is a C-language software program.
* SAMPLE1.PAS: This program is written for PASCAL applications.
* SAMPLE1.BAS: This program is written for QuickBASIC applications.
* VBACCES: A visualBASIC utility driver that includes PEEK and POKE statements for reading and writing RAM as well as INPORT and OUTPORT for reading and writing I/O. The driver is in the form of a DLL and allows you to access hardware as if the language was designed for it when you use VisualBASIC for Windows.

VisualBasic Utility Driver

Extensions to the VisualBASIC language are provided with your card. The extensions are in a directory named VBACCES. These extensions are in the form of a .DLL, a .GBL, and a VisualBASIC sample. Together these files allow you to access the port and main memory space in a fashion similar to BASIC, QuickBASIC, Pascal, C/C^{++}, Assembly, and most other standard languages.

To use these files in a VisualBASIC program, you must create a .MAK file (File l New Project) similar to the sample provided (or else, modify your existing project file) and include the .GBL file (File | Add File). Once this has been done, VisualBASIC will be enhanced with the addition of the following functions.

InPortb

Function: Reads a byte from a hardware port. Due to limitations of VisualBASIC, the number is returned in an integer.

Declaration: `function InPortb(byval address as integer) as integer`

InPort

Function: Reads an integer from a hardware port. This function returns the 16-bit value obtained from reading the low byte from address and the high byte from address+1.

Declaration: `function InPort(byval address as integer) as integer`

OutPortb

Function: Writes the lower eight bits of value to the hardware port at address. This function returns the value output.

Declaration: `function OutPortb(byval address as integer, byval value as integer) as integer`

OutPort

Function: Writes all 16 bits of value to the hardware port at address. This function returns the value output.

Declaration: `function OutPort(byval address as integer, byval value as integer) as integer`

Peek

Function: Reads a byte from main memory (DRAM).

Declaration: `function Peek(byval segment as integer, byval offset as integer) as integer`

Poke

Function: Writes the lower eight bits of *value* to *segment*:*offset*.

Declaration: `function Poke(byval segment as integer, byval offset as integer, byval value as integer) as integer`

Note that in all of the above functions, an inherent limitation of BASIC in general and VisualBASIC in particular makes the values sent less intuitive. All integers in BASIC are signed numbers, wherein data are stored in two's complement form. All bit patterns must be converted to-and-from this two's complement form if meaningful display is required. Otherwise, values returned from the InPortb function will be -128 to 127, rather than 0 to 255. An alternative is to perform all assignments in hexadecimal, rather then decimal form.

Before the program will execute, the .GBL file must be modified to include the path to the VBACCES.DLL as appropriate for your system. Merely replace the statement "VBACCES.DLL" with "drive:path\VBACCES.DLL".

As an alternative to changing the source code, you can copy the VBACCES.DLL file into your Windows directory. This will allow multiple programs to find the same .DLL without having to know where it is located. Just leave off all references to a path in the .GBL file as shown in the sample.

Chapter 6: Programming

DIO48I Series cards are I/O-mapped devices that are easily configured from any language and any language can easily perform digital inputs through the card's ports. This is especially true if the form of the data is byte or word wide. All references to the I/O ports would be in absolute port addressing. However, a table could be used to convert the byte or word data ports to a logical reference.

A total of eight address locations are used by the DIO48I. Register locations are listed in the following table.

ADDRESS SELECTION TABLE

Address	Read	Write
Base Address	Port 0 Low Byte	unused
Base Address +1	Port 0 High Byte	unused
Base Address +2	Port 1 Low Byte	unused
Base Address +3	unused	unused
Base Address +4	Port 1 High Byte	unused
Base Address +5	Port 2 Low Byte	Free up µprocessor*
Base Address +6	Port 2 High Byte	unused
Base Address +7	unused	unused

* NOTE: After any read, the change of state interrupt is cleared, and the microprocessor is disabled. Write to Base Address +5 to re-enable the microprocessor.

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Chapter 7: Connector Pin Assignments

Three identical 50-pin headers are provided on the DIO48; one for each 16-bit input group. The mating connector is an AMP type 1-746285-0 or equivalent. Connector pin assignments are listed below. Alternate wires associated with each bit pair should be connected to ground at the source end of the cable. This will provide partial shielding between signals.

Pin	Signal	Pin	Signal
1	Ground	2	No Connection
3	Bit 0 High	4	Bit 0 Low
5	No Connection	6	Bit 1 High
7	Bit 1 Low	8	No Connection
9	Bit 2 High	10	Bit 2 Low
11	No Connection	12	Bit 3 High
13	Bit 3 Low	14	No Connection
15	Bit 4 High	16	Bit 4 Low
17	No Connection	18	Bit 5 High
19	Bit 5 Low	20	No Connection
21	Bit 6 High	22	Bit 6 Low
23	No Connection	24	Bit 7 High
25	Bit 7 Low	26	No Connection
27	Bit 8 High	28	Bit 8 Low
29	No Connection	30	Bit 9 High
31	Bit 9 Low	32	No Connection
33	Bit 10 High	34	Bit 10 Low
35	No Connection	36	Bit 11 High
37	Bit 11 Low	38	No Connection
39	Bit 12 High	40	Bit 12 Low
41	No Connection	42	Bit 13 High
43	Bit 13 Low	44	No Connection
45	Bit 14 High	46	Bit 14 Low
47	No Connection	48	Bit 15 High
49	Bit 15 Low	50	No Connection

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Chapter 8: Specifications

Features

- Individually-isolated Digital Inputs for up to Three 16-Bit Groups.
- Polarity-Protected Input Voltage Amplitudes to 28V and 60 V.
- 500 Vrms Isolation, Channel-to-Channel and Channel-to-Host PC.
- Some Models Have On-Board Microcontroller and Can Generate Interrupts When Bits Change State.
- On-Board Shield Prevents Accidental Contact with User Voltages.

Digital Inputs

Logic 0: Open or 1.5V maximum.

Logic 1:
28V Models: 3.0V min. at 0.6 mA.
28V max. at 13 mA.
60V Models: 2.4V min. at 2.0 mA.
60V max. at 2.3 mA.

Frequency Response:
28V Models: Up to 5 KHz
60V Models: Up to 10 KHz

Isolation: 500 Vrms channel-to-channel and channel-to-computer. (Note: Alternate wires in the ribbon cables are not connected at the card, thus providing bit- to-bit isolation higher than that normally provided by ribbon cables.)

Power Required :

+5VDC at 300mA maximum.

Environmental

Operating Temperature Range: 0^{o} to 60^{o}C

Storage Temperature Range: -20^{o} to $+100^{o}$C

Humidity: 0% to 90% RH without condensation.

Size:

13.310" long.

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Declaration of Conformity

INDUSTRIAL COMPUTER SOURCE®

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San Diego, CA 92121-2720
(800) 523-2320

Industrial Computer Source declares under its own and full responsibility that the following products are compliant with the protection requirements of the 89/336/EEC and 73/23/EEC directives.

Only specific models listed on this declaration and labeled with the CE logo are CE compliant.

DIO16I/28	**DIO16I/60**	**DIO16SI/28**	**DIO16SI/60**
DIO32I/28	**DIO32I/60**	**DIO32SI/28**	**DIO32SI/60**
DIO481/28	**DIO48I/60**	**DIO48SI/28**	**DIO48SI/60**

Conformity is accomplished by meeting the requirements of the following European harmonized standards:

EN 50081-1:1992 Emissions, Generic Requirements.

-EN 55022 Measurement of radio interference characteristics of information technology equipment.

EN 50082-1:1992 Immunity, Generic Requirements.

-IEC 801-3:1984 Immunity for radiated electromagnetic fields.
-IEC 801-4:1988 Immunity for AC and I/O lines, fast transient common mode.
-IEC 65A/77B Immunity for AC lines, transients, common, and differential mode.

EN 60950:1992 Safety of Information Technology Equipment.

Information supporting this declaration is contained in the applicable Technical Construction file available from:

INDUSTRIAL COMPUTER SOURCE EUROPE®

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April 22, 1997
San Diego, CA

Mr. Steven R. Peltier
President & Chief Executive Officer

BUG REPORT

While we have tried to assure this manual is error free, it is a fact of life that works of man have errors. We request you to detail any errors you find on this BUG REPORT and return it to us. We will correct the errors/problems and send you a new manual as soon as available. Please return to:

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Product: **DIOxx(S)I**

Manual Revision: **00650-131-4A**

Please list the page numbers and errors found. Thank you!